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SOIL MOISTURE PLOTTING PROGRAM

Contract No.KW504-7-1419
Division of Hydrology
University of Saskatchewan, Saskatoon

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ABSTRACT

A soil moisture program, called 'Scaler', provides an integrated environment for handling twin-probe soil-moisture data, from the field through to data analysis. It runs on the simplest PC laptop for field verification of data and on a PC or AT for more sophisticated data analysis. The graphics resolution for a laptop it is typically 640 x 200 and 720 x 348 for non-portable computers.

From the program the operator selects the required functions. These include transferring field data from the scaler to the PC, updating existing count files or completing the processing of raw data transferred earlier from a scaler. Once a count file is processed it can be compared with previous profiles to ascertain whether it needs to be done again. This is very important as these profiles are measured under extreme working conditions and loss of measured data, when a significant moisture event occurs, can seriously affect the research programme.

Soil Moisture Program - October 88.

The Soil Moisture Program called 'Scaler' provides an integrated enviroment for handling twin probe soil moisture data from the field through to data analysis. The program is designed to run on the simplest PC laptop for field verification of data and on a PC or AT for more sophisticated data analysis. The resolution of the graphics is determined by the graphics adapter. For a laptop it is typically 640x200 and 720x348 for non portable computers. The data base is determined by the disc capacity. With one 3 1/2 inch floppy drive there is sufficient disc storage to hold archive data and new profile data collected during several days of field work.

The program displays a menu from which the operator selects the required function. These include transferring field data from the scaler to the PC. Updating existing count files or completing the processing of raw data transferred earlier from a scaler. Once a count file is processed it can be compared graphically with earlier profiles measured at the same site. This permits the reference standard count to be adjusted to take in to account physical characteristics of the profiles. From these graphs it is immediately possible to ascertain the quality of a profile and decide if it needs to be done over again. This is very important as these profiles are measured under extreme working conditions for man and equipment, and loss of measured data when a significant moisture event occurs can seriously affect the research program .

Loading Program

The PC should be started up according to the manufacture's instructions. The active directory should be changed to \COUNT\ by entering 'CD\COUNT\'. Then typing 'SCALER' will run the program. The organisation of the disc storage and transferring of base data is covered in a later section. For the moment it is assumed that the archive files are already present on disc.

Scaler Dump

The following steps should be carried out to transfer the contents of the scaler memory to the PC.

1. Connect the scaler to the COM1 serial port on the PC.

2. Power up the scaler.

3. On the PC keyboard depress F3 to initiate the Dump function.

4. On the scaler instigate transfer by depressing '3' followed by 'Y'.

5. The completion of the transfer will be displayed on the PC. During the transfer do not touch the keyboard of the PC as this

will prematurely terminate the transfer. This feature is included to help salvage data from 'zapped' scalers.

6. The data is stored in a temporary raw data file in the directory \JUNK\. The naming convention for these files is 'HYddhhmm', where ddhhmm is the current day, hour and minute from the PC internal calendar and clock. A raw data file created at 1:32pm on the 8th of any month would be named 'HY081332'.

7. The program now enters a pre-edit mode which allows the operator to correct for errors made in scaler data entries in the field. The scaler program is capable of assisting the operator by duplicating certain data items not always entered in the field and these are listed below in point form and need not be entered by the operator.

a. Duplication of references shared between profiles. The following combinations are admissable.

...CCCCCCRRHCCCCCCCCCCC...etc

...CCCCCCRHRCCCCCCCC...etc

...CCCCCCHRRCCCCCC...etc

N.B. Two sets of references must always appear at the beginning of the first profile and at the end of the last.

b. The first header in the scaler raw data file must be complete but subsequent ones need only have the region and site number. The program will copy the remainder of the information from the first header to succeeding ones.

Examples of errors that need to be corrected are as follows.

a. The five poly references must proceed the five magnesium references.

b. Any redundant headings, references and counts must be removed completely.

c. All region and site numbers should be checked and corrected at this time to prevent confusion later on.

8. The common edit commands are described in full in appendix A. The pre-editor exit commands are as follows.

^KD Exits the pre-editor and continues into the next stage of processing the soil moisture profiles. All profiles need not be 100% correct but it is important that the region, site and date be correct for all profiles or difficulties could arise later.

^KQ This is used to exit from the pre-editor when it is not desired to continue processing the soil moisture profiles or the conditions outlined above cannot be met. The data is saved in the raw data file with or without changes depending upon the response to the prompt.

9. The scaler program enters into a profile-editor mode. Each profile is displayed in turn and the operator checks for errors. This is facilitated by the program displaying the header information in expanded form at the bottom of the screen.

At the end of the header line the program adds the name of the gravimetric file associated with this profile. As this is

derived from the archive profile data stored the on the disc the name of the gravimetric file can not always be determined and displayed if the data base is incomplete.

The poly calibration and a status word is added to the end of the first reference line. The poly calibration is subsequently used to convert the profile counts into moisture content. The status word is a measure of the reference count stability. It is a three digit number. The first digit is the number of poly readings within ± two standard deviations of the mean count of all the poly readings at the beginning of the profile. The second digit is the same for the poly readings taken at the end of the profile. The third digit is a measure of the reference quality and is derived from a statistical comparison of the poly means, and the ratios of the poly to composite counts, taken before and after the profile. Values are as follows :

1 - both poly means and ratios within the acceptable range.

2 - only poly means within range.

3 - only ratios within range.

4 - neither within range.

A status value of 551 is good. A value of say 354 would indicate that possibly the operator had not waited for the equipment to reach equilibrium before commencing the profile. The profile editor will not let the operator change the poly calibration and the status word at this point of the program.

10. The profile editor exit commands are as follows.

^KD Exits the profile editor and handles files as follows. If the profile is raw data, it is saved as a count file in the directory \count\. If the profile is an existing count file, the original file will only be overwritten if the profile has been altered. The profile is put on the profile process list (PPL).

^KQ Exits the profile editor and handles files as follows. If the profile has been altered the operator is prompted to determine if the changes should be ignored. If changes are to be kept the program proceeds as for ^KD otherwise no file changes are made and nothing is added to the PPL.

^KU Does not exit from the profile editor but updates the screen display of region/site/date/gravimetric file/etc.

Notes

i If the edit screen is deleted completely the profile is purged. This removes a raw profile from the raw data file but has no affect on count files. Nothing is added to the PPL.

ii Before saving a profile as a count file a check is made to determine if the region/site/date etc is legal. If it is in error, the operator is prompted to correct the error and failure to do so results in the file not being saved or added to the PPL.

File Editing and Processing

Depressing F4 when the main menu is displayed prompts for entry of a file name. This may either be a raw data file or a count file. The program determines the nature of the file and proceeds to step 7 above if it is a raw data file or step 9 above if it is a count file. When entering the file name it would normally be preceeded by \junk\ or \count\ if is a raw data file or count data file respectively.

Graphics

Before selecting the graphics mode one or more profiles have to be entered into the profile process list (PPL) by using F3 to dump a scaler or F4 to pickup an existing count file or raw data file. These are referred to as seed profiles and select the series of profiles which are displayed in the graphics mode. The seed profile will be centred on the initial graphics display.

Graphics is selected by depressing the function key F6. The profiles on the PPL are processed one at a time as follows. Using the Region and Site data a search of directory \count\ is made to find all count profiles fitting the Region and Site description. Since all count profiles in a series must have the same gravimetric file, any count profiles prior to the date of the gravimetric file of the seed profile are rejected. Similarly, profiles dated on or after the date of the next gravimetric file are rejected.

The graphics mode is described in the next section titled 'Scaler Program Graphics'. This write-up uses a demonstration disc of data collected in earlier years of the research program.

Appendix A.

Editor Commands.

Character left	Ctrl-S or Left arrow
Character right	Ctrl-D or Right arrow
Word left	Ctrl-A or Ctrl-Left arrow
Word right	Ctrl-F or Ctrl-Right arrow
Line up	Ctrl-E or Up arrow
Line down	Ctrl-X or Down arrow
Scroll up	Ctrl-W
Scroll down	Ctrl-Z
Page up	Ctrl-R or PgUp
Pagw down	Ctrl-C or PgDn
Beginning of line	Ctrl-Q S or Home
End of line	Ctrl-Q D or End
Top of screen	Ctrl-Q E or Ctrl-Home
Bottom of screen	Ctrl-X or Ctrl-End
Top of block	Ctrl-Q B
Bottom of block	Ctrl-Q K
Jump to marker 0..3	Ctrl-Q 0..Ctrl-Q 3
Set marker 0..3	Ctrl-K 0..Ctrl-K 3
Previous cursor position	Ctrl-Q P
New line	Ctrl-M
Insert line	Ctrl-N
Insert control character	Ctrl-P
Tab	Ctrl-I or Tab

Delete current character	Ctrl-G or Del
Delete character left	Ctrl-H or Backspace
Delete word	Ctrl-T
Delete to end of line	Ctrl-Q Y
Delete line	Ctrl-Y
Find	Ctrl-Q F
Find-and-replace	Ctrl-Q A
Find next	Ctrl-L
Begin block	F7 or Ctrl-K B
End block	F8 or Ctrl-K K
Copy block	Ctrl-K C
Move block	Ctrl-K V
Delete block	Ctrl-K Y
Hide block	Ctrl-K H
Mark current word as block	Ctrl-K T
Read block from file	Ctrl-K R
Write block to file	Ctrl-K W
Print block	Ctrl-K P
Toggle insert mode	Ins or Ctrl-V
Toggle autoindent mode	Ctrl-O I
Toggle fixed tabs	Ctrl-O T
Restore line	Ctrl-Q L
Exit editor	Ctrl-K D
Abort editor	Ctrl-K Q

Note: When the notation Ctrl- precedes another key, it means that you hold down the Ctrl key and press the second key.

Put the floppy disc in drive A. The content format of this disc is described in appendix A. Enter 'A:' and at the A> prompt, type 'SCALER' enter and wait until the menu on the program title page displays indicating that the program has loaded.

Next depress the function key, 'F4' to select 'Input File'. The given count file name is used as a seed to find all the data available for that particular location. For this demonstration enter '\COUNT\03CPCB'. The file will be displayed allowing the user to edit the file contents. Type '^KD', ie control 'K' followed by 'D'. Letter case does not matter so any of the following combinations are permissible; '^kd', '^Kd' etc. The character '^' is used to indicate that the control key is held for the next character. Ignore the '0 Files Created' message.

In response to the menu display depress the 'F6' function key to select 'Plot Profiles'. The disc drive will churn away for approximately 20 seconds. During this time a search is made to find all the count files for the data collection site. The program also determines the name of the gravimetric file which contains all the site physical data, ie tube spacing, tube size, skew, the initial soil core data and the site description text.

The program will display three soil moisture difference plots presenting the changes in soil moisture between adjacent sample times centred around the initial seed date. This is the main display and the program always returns to this display after being in the other single display modes. The centre date is initially the seed date but may be advanced or retarded by using the cursor left and right keys. The centre

date is always indicated with asterisks, eg 87*03*21, other dates use slashes, eg 88/09/23. Along the bottom of the display appears the region, site number, seed file name, gravimetric file name, centre date file name and measurement date, scaler, detector, block, the calibration status, the calibration count and finally the initial calibration count, if the user has adjusted the current calibration count or otherwise a zero. At the top of the individual plots are the dates defining the period over which the soil moisture changes have occurred. The calibration count can be changed by entering a number between 10,000 and 50,000; or by using the '+' and '-' keys to increase or decrease the count by 5%. If 'n' or 'N' is depressed the original calibration count is restored. It is worth noting that at this point in the program, the count files are not changed in mass storage. However, when the current graphics mode is terminated the user is queried to determined if any changes should be made permanently to the database.

When it is necessary to display the moisture change between two dates that are not adjacent, ie other measurements dates separate them in time, a single display mode is available. First the desired reference date should be made the centre date in the three plot display mode, then depress the function key 'F9'. The screen will clear and a single plot of soil moisture change over the period between the centre date and the previous measurement will be displayed. Now if the cursor right/left keys are used, the soil moisture change between the centre date and any available data measurement may be displayed. Along the bottom of the screen the measurement dates are displayed together with file names. If profile temperature data is available fot the centre date profile, it

will be displayed. Data may be extracted from the display by using the cursor up/down keys and the PgUp/PgDn keys. The data extraction function is enabled by depressing the cursor down key. Immediately, a table will appear on the righthandside of the screen. The table displays an upper and a lower level. The level flagged with an asterisk is the currently active level. This means that the cursor Up/Dn keys will change this depth. To change the active level use the PgUp and PgDn keys, the asterisk will move up and down respectively. On the graph the area between the upper and lower level will be highlighted in inverse video. In the table, the soil moisture change will be displayed for each level together with the mean soil moisture change and water equivalent for the column of soil contained by the two levels. This table is automatically updated as the two levels are modified by the user using the cursor up/down keys and the PgUp/PgDn keys. When the data extraction mode is enabled it remains active until disabled by making the two depths the same. this feature makes it easier to compare a column of soil over different time periods. The 'End' key will return the user to the three plot graphics display.

To allow for comparison with gravimetric data a display of moisture content as a % by volume is available by depressing the function key 'F10' from the three plot display. This single plot display presents the moisture content of the 10 cm soil cores derived from the drill cores and also the soil saturation values. The soil moisture change between the current profile and the initial profile completed when the site was establised is added to the 10 cm core data to generate an absolute plot of moisture content as a % by volume. All the data available for the

site may be displayed by stepping through them using the Left/Right cursor keys. The data extraction feature is available by using the PgUp/PgDn keys as described previously. Note that the data extraction levels, once set are remembered even when different profiles are selected or the display is changed between soil moisture change (F9) and % by volume (F10). Another point worth noting is that it is not possible to go directly between the soil moisture display and the % by volume display without first going through the three plot graphical display. A sample sequence of keys would be 'F9', 'End' then 'F10'.

Summary.

Loading Program

Put disc in drive A. Disc may be write protected.

'A:', enter

'Scaler', enter

When title screen appears program is ready.

Selecting Profile

Depress 'F4' to select 'Input File'.

'\COUNT\O3CPCB', enter. (Upper or lower case may be used)

Wait for display to fill with profile data.

Type '^KD', this means hold the control key and type 'K', release control key and type 'D'. Other permissable variations are: '^K^D', '^kd', '^kD' etc. '0 Files Created' message will be displayed on the status line.

Depress 'F6' to select 'Plot Profiles'. After 20 seconds three profile plot will appear.

Three Profile Plot Display Commands

Use cursor Left/Right keys to scan profiles.

Use '+', '-', 'N'or 'n', a numeric value between 10000 and 50000 followed by enter, to change calibration count.

Use 'F9' to go to single non-adjacent moisture change plot.

Use 'F10' to go to single % by volume gravimetric plot.

N.B. Since some of these operations requires the computer to calculate and display new values, allow the program to finish the current operation before pressing further keys.

Single Plot Display

Use 'End' to exit back to the three plot display.

It is not possible to go from a single plot mode to the other without going through the three plot display.

Data Extraction Mode

Initially entered by depressing the cursor down key in a single plot display.

Change active level depth using cursor Up/Dn.

Change active level using PgUp and PgDn.

Disable by making both depths the same.

Terminating Program

Continue to press 'End' until menu on program title page is displayed. Then hold down the Alt key and press 'X' or 'x'.

Appendix A.

Summary of Disc Contents.

In the root directory is the executable file SCALER.EXE together with support Pascal routines, 8X8.FON, 4X6.FON and ERROR.MSG. The program will only run on the display type it is configured for. In this case CGA. A Hercules version is available.

There are three sub-directories, 'COUNT', 'GRAV' and 'TEMP' containing the count files, gravimetric files and temperature files respectively.

Appendix B.

File Naming Format.

All names are six characters long with no extension.

Col 1

Is a alpha character indicating region, eg 'K' for Kerrobert.

Col 2

Is an alpha/numeric character indicating site number. Sequential order is 1..9, A..Z.

Col 3

Data type. 'A' for gravimetric, 'C' for count and 'W' for temperature.

Col 4

Years 1983 through 1988 represented by 'M' through 'R'.

Col 5

Months January through December represented by '1'..'9' and 'A'..'C'.

Col 6

Day of Month represented by '1'..'9' and 'A'..'V'.

Division of Hydrology

Soil Moisture Profile Processing

September 1988

F3-Dump F4-Input File F5-Display F6-Plot Profiles F7-?????

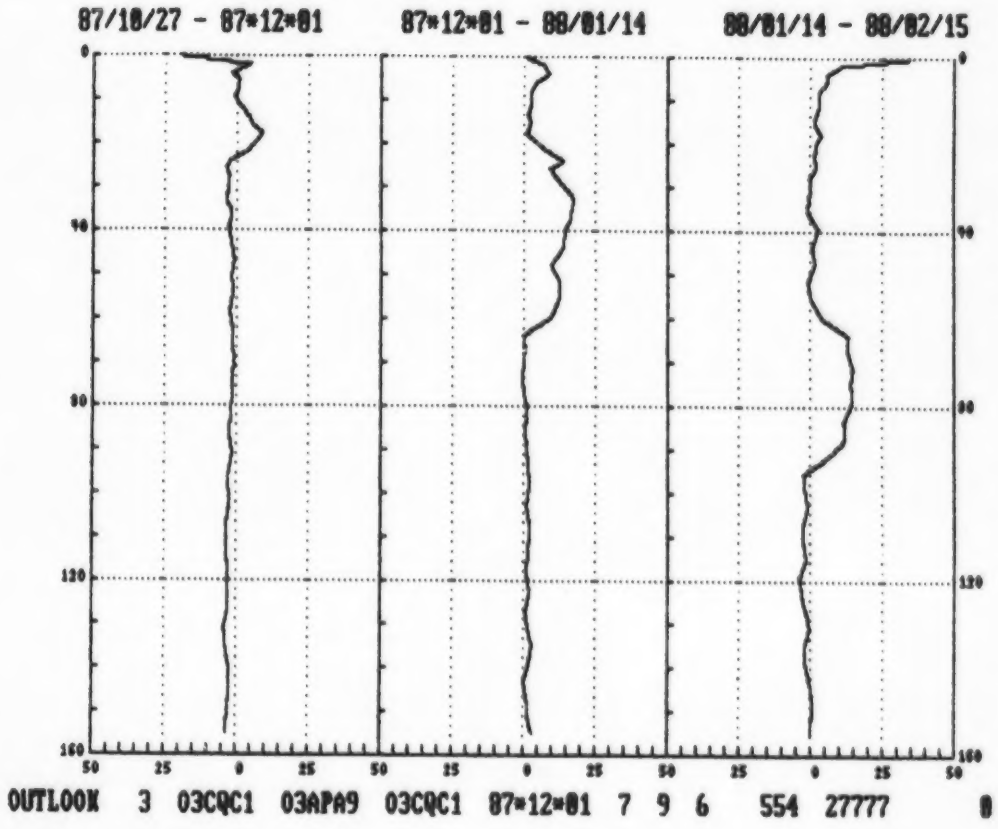
Program Title Display and Menu

```
          Line 1     Col 1     Insert                C:O3CPCB
H    0203 121110 020440 050105   0186      O3APA9
R  31584  31872  31692  32083  31953       552  31871
R  21275  21214  20989  21027  20721
C127288  26719  23346  21233  18997  15855  16848  17579  18598  16352
C  15801  16444  15718  16343  16579  18095  18573  18640  18379  18595
C  17151  17165  19017  18656  18917  20524  19202  19800  19122  19531
C  19742  19461  19576  20930  19442  19643  19615  20106  19974  20978
C  20578  21621  24966  24498  23642  23462  23781  23341  23066  21025
R  31903  32047  31821  31882  31876
R  21366  21704  21633  21532  21529
```

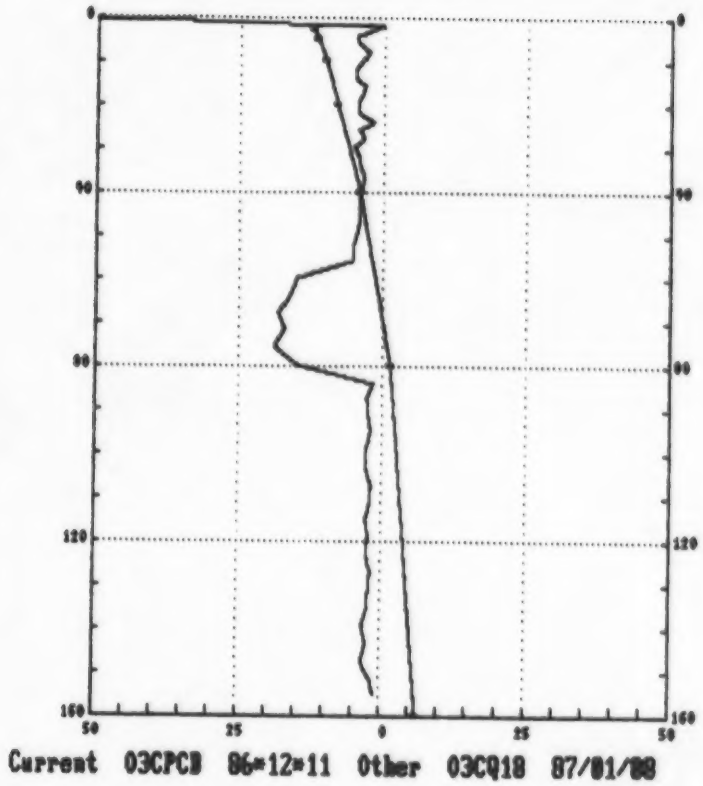
OUTLOOK # 3 date 11-12-86 Scaler 5 Detector 1 Block 5 NoChange

Profile Editor: ^K^D -save as Count file, ^K^U -update Screen or ^K^Q -quit

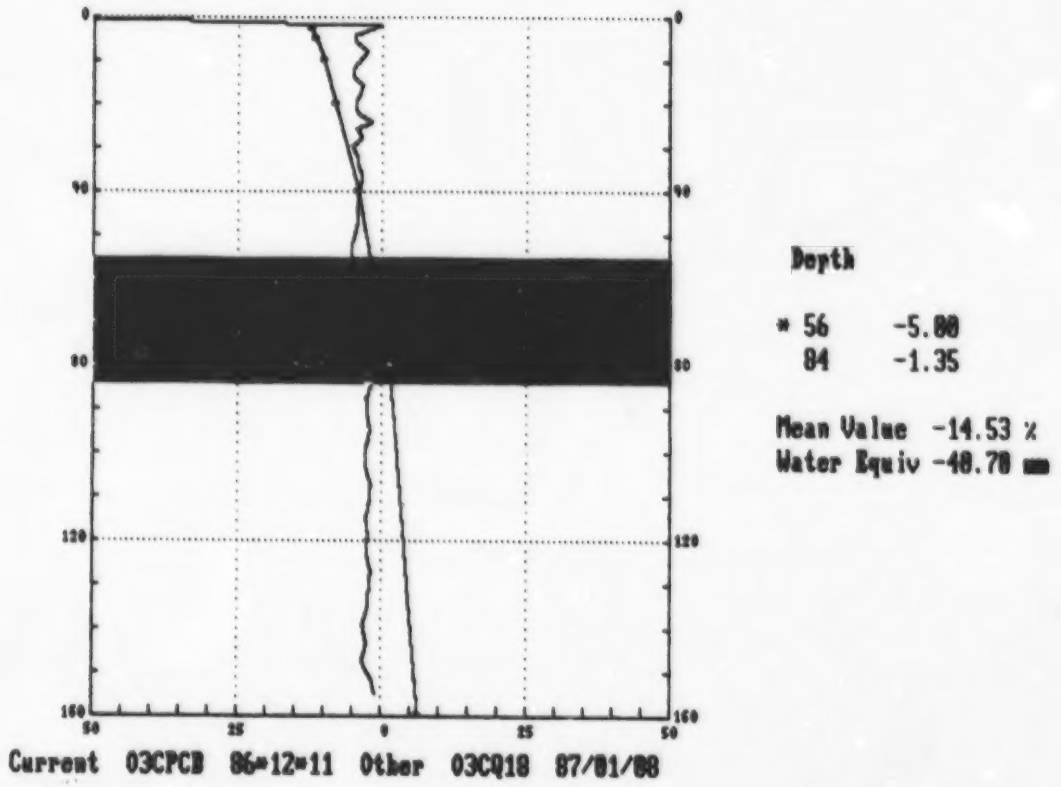
Profile Edit Display



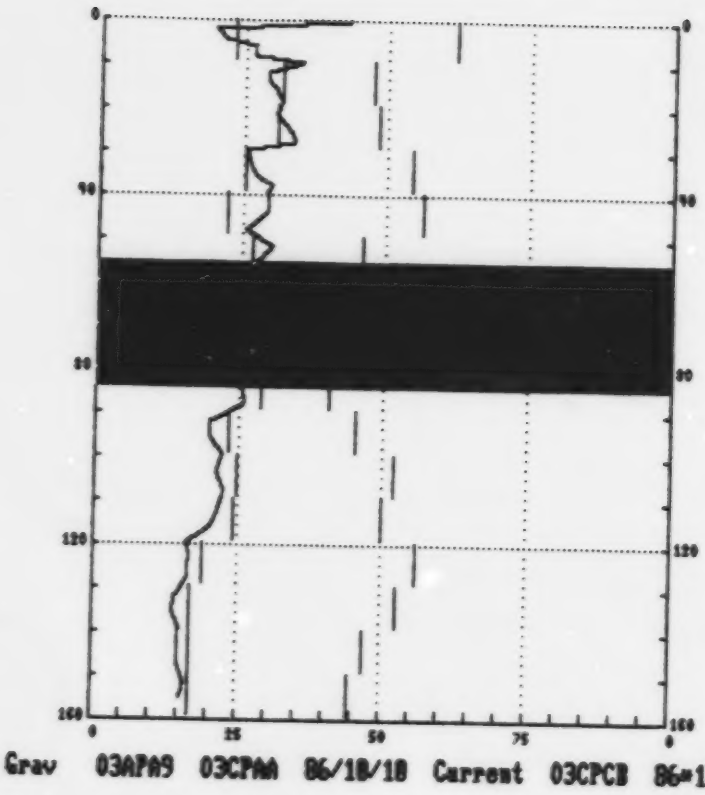
Three Plot Soil Moisture Change Profiles



Soil Moisture Change with Temperature Profile (F9)



Showing Data Extraction on Soil Moisture Change Display (F9)



Depth

* 56 27.33
84 25.52

Mean Value 19.82 %
Water Equiv 55.50 mm

Showing Data Extraction on % by Volume Display (F10)